

RESEARCH

● M^a Paz Prendes, Linda Castañeda & Isabel Gutiérrez
Murcia (Spain)

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ICT Competences of Future Teachers

Competencias para el uso de TIC de los futuros maestros

ABSTRACT

ICT (Information and Communication Technologies) competences are an essential part of teachers' curricula in Spain. This paper presents an analysis of the technical skills in the use of ICT of future primary school teachers in the final year of teacher training at the University of Murcia (period 2008-2009). This analysis adopts a three-dimensional approach. Firstly, it aims to explore students' mastery of the technical skills in using ICT. Secondly, it analyses how the university is working on the development of ICT skills in professionals in general. Finally, but probably most importantly, it attempts to show the current ICT levels of the future school teachers. This analysis is crucial, and not only for teachers who are already working. It is equally, if not more so, for newly trained teachers on the point of going into formal education in schools. Therefore, this study helps us to evaluate them not only as students, professionals and teachers who use ICT, but at the same time it help us to assess if a course at a Higher Education institution is a real way of obtaining minimum knowledge of this area. This is crucial in integrating new teachers into the new social and technological environment and it makes the evaluation of cross-curricular competences in the University of Murcia.

RESUMEN

Las competencias tecnológicas de los maestros son un elemento básico de sus planes de formación en España. En este artículo se presenta un análisis de las competencias para el uso de TIC por parte de estudiantes de último curso de la titulación de Magisterio de la Universidad de Murcia en el curso 2008-09. El objetivo ha sido describir el grado de competencias técnicas que poseen los futuros maestros. El análisis de los datos se ha realizado desde un enfoque tridimensional, pues en primer lugar se han considerado aspectos del dominio técnico; en segundo lugar se ofrece una visión de cómo se encuentra dicha competencia en los estudiantes; y por último –y probablemente lo más relevante–, se considera cuál es el estado de competencia técnica para el uso de las TIC que tienen los docentes de futura incorporación a nuestra aulas. Este análisis permite no sólo evaluarlos como estudiantes, profesionales y docentes que usan las TIC, sino que permite tener una idea de si el paso por una institución universitaria supone la garantía de tener unos mínimos conocimientos en esta área que sean de utilidad a la hora de incorporarse como profesionales, docentes y aprendices del nuevo entorno tecno-social, es decir, permite una aproximación a la evaluación de las competencias TIC que son no sólo propias de este título de Grado, sino también son competencias genéricas de la Universidad de Murcia.

KEYWORDS / PALABRAS CLAVE

Technology enhanced learning, basic skills, digital literacy, ICT competency, teacher training, indicators, technical skills, higher education.

Tecnología educativa, competencias básicas, alfabetización digital, competencias TIC, formación del profesorado, indicadores, dominio técnico, educación superior.

- ◆ Ph.D. M^a Paz Prendes Espinosa. Full Professor of the Department of Didactics of the Faculty of Education at the University of Murcia and the Head of the Research Group of Educational Technologies in Murcia (Spain) (pazprend@um.es).
- ◆ Ph.D. Linda Castañeda Quintero. Professor of the Department of Didactics and Organization of Schools of the Faculty of Education at the University of Murcia (Spain) (lindacq@um.es).
- ◆ Isabel Gutiérrez Porlán. Assistant Professor of the Department of Didactics and Organization of Schools of the Faculty of Education at the University of Murcia (Spain) (isabelgp@um.es).

1. Introduction

The scientific literature (Gilster, 1997; Prados, 2001; Kellner, 2004; Koehler & Mishra, 2008; Kress, 2005; Camps, 2009) of recent years has reflected the concern about users' ICT competence. This general social concern is borne out in the interest in knowing and reinforcing the levels of ICT competence among teachers at all levels of education (as is clearly illustrated by, among others, Aguiar and Llorente, 2007; Bullón et al., 2008; Cabero & Llorente, 2006; Cabero & Llorente, 2007; Cabero & al, 2009a; Cabero et al., 2009b; Fernández, 2007; Martínez, 2008; Reyes & Piñero, 2009, Tello & Aguaded, 2009). Given that technical know-how is a transversal basis of teachers' skills in the use of ICT, we offer here an analysis of this aspect with a sample of final year teacher training students from the University of Murcia.

We believe that the sample allows for a three dimensional reading of the results. First, we understand that it provides an interesting view of these students' technical mastery. Secondly, it offers a view of the level of this competence in a section of the students at the university in question, insofar as it is an institution that trains future professionals. Finally, and probably most relevant of all, it provides information about the level of technical competence of our future, in some cases immediately so, teachers. All these matters are highly relevant in today's techno-social environment that demands the effective and efficient incorporation of ICT in education in general and in the university in particular (Castañeda, 2009).

1.1. Technical competence as a transversal part of teachers' technical competence

As the Chilean Ministry of Education correctly states in its 2006 document, it is clear that in terms of ICT, a teacher's competence is made up of various areas that together make up the outline of what could be considered as an «adequate» or «efficient» use of these technologies. In other words, according to the document cited, for a teacher to be considered ICT competent, s/he should be competent in at least five, closely related, areas: the pedagogical area; knowledge of the social, ethical and legal aspects related to ICT use in teaching; skills for ICT based school management; the use of ICT in teachers' professional development; and the area of technical know-how.

Like the authors of the above study, we see each of these areas as being of great use in the teacher's make-up. Yet if we go a little more deeply into the area of technical know-how, we would say, in line with the approaches taken by several authors (Chilean Ministry

of Education, 2006; Cabero, 2006 and BECTA, 2008), that it should include the management of the concept and basic functions associated to ICT and the use of personal computers, the use of productivity tools (word processors, spreadsheets, presentation programs) to create various types of documents, the management of concepts and, of course, the use of Internet and web tools themselves as well as synchronous and asynchronous communication resources to access and disseminate information and establish remote communications.

Thus, if we consider that of the five areas that make up teachers' competences in ICT use, there is one that is transversal not only to a teacher's make-up but also to that teacher's condition of worker and student – that of technical know-how. And this seems to be so when viewed from the triple transversal approach, which we believe is where the real importance of the analysis lies. The analysis in question is not only important as regards practising teachers but also for those at training centres who are about to join the labour market. It will allow us not only to assess them as students, professionals and teachers who use ICT, but will also give us an idea as to whether the university institution experience is a guarantee of minimum knowledge in this area that will be useful to them when they move on to become professionals, teachers and trainees in the new techno-social environment.

2. Material and Methods

2.1. Background

The questionnaire used to collect the data is an adaptation of that developed by Cabero, Llorente et al. (2006) for their analysis of student ICT mastery, and which was also used in the study by Cabero, Llorente and Puentes (2009). The only adaptations made here respond purely to making the questionnaire fit in with the particular features of the technological environment of the University of Murcia, in terms of both the physical equipment and the virtual classroom.

All the skills assessed through the various items in the questionnaire can be grouped into four general categories that will guide the analysis we offer later. The first refers to aspects related to use and knowledge of the computer and its peripherals and to program installation and configuration. The second group of competences has to do with aspects related to the Internet (communication, information, collaboration...). The third category includes items that measure competences referring to working with text documents, management of information through databases and spreadsheets, creating and editing images, sound and

multimedia. The fourth category takes in a series of items related to the various tools available at the University of Murcia (Online campus, webmail, among others).

2.2. Description of the study

Final year teacher training students from four of the six specialities – Primary School; Foreign Languages; Music; Special Education were invited to take part in the study. In absolute terms, of the 751 final year students the invited sample comprised 482, 64.2% of the possible universe. The final sample was made up of 351 students (72.9% of those invited and 46.8% of the universe). Of these, 319 (91%) were females and 32 (9%) males. The age range stretched from 19 to 58 years olds, although the majority (79%) were between 20 and 24 years, and 37% of the total were 20 years old.

The distribution of the sample according to specialities, although not totally homogeneous, is quite similar, as the graph below shows:

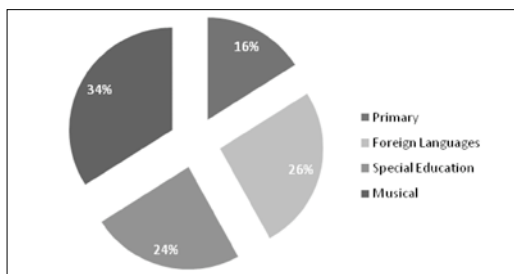


Figure 1. Distribution of the sample according to specialities.

Almost all (97%) of the students comprising the sample had a computer at home. 89% had access to Internet and 70% enjoyed exclusive access to a laptop. Furthermore, the majority (88%) use their own computer to do their coursework, with a very low number (8%) using the university computers and only 4% resorting to the use of other equipment (computers belonging to friends, flatmates, cyberspaces, cultural centres, etc.).

3. Results. Data analysis

Below we give a general outline of the results obtained for

each group of competences. Responses are distributed over a scale from 0 to 10, with 0 being the minimum value and 10 the maximum. In this analysis we have considered as priority the statistics that described the sample, and so the focus has been, on the one hand, on the mean obtained by the group for the different skills and on the typical deviation of the values, which gives us a perspective of the group, and, on the other hand, on the percentages of students situated above and below the midpoint (5), taking this point as the indication as to whether a student considers that s/he is able to perform the actions proposed (pass). We believe that this provides a better view of the perspective of each student as regards his or her technical skills and competences in ICT use.

3.1. The use of the computer, installation and configuration of programs and their peripherals

The table below gives the means and typical deviations and the percentages above the midpoint obtained by the students for each of the competences in this category.

As this table shows, the mean scores obtained by the students in most of the competences surveyed are over five, meaning that, in general terms, our students «pass» in matters relating to the use of the computer and program installation. The highest mean scores correspond to knowledge of the computer and its peripherals and to knowledge of how to access, search for and retrieve information in various formats. Moreover, these competences show a low typical deviation (see table above), which indicates that there

Competences	Mean	Typical deviation	Have this competence
Can connect up audio, camcorder and digital camera equipment to computers	8.01	2.01	95 %
Can access, search for and retrieve information in different formats (CD-Rom, DVD, video, USB memories)	7.58	2.44	95 %
Is familiar with computers and their most usual peripherals	7.57	2.22	95 %
Has basic computer user knowledge	7.30	1.75	95 %
Can use the keyboard appropriately to produce alphanumeric characters and punctuation signs	6.98	2.50	86,2 %
Can install and deinstall programs in the computer	6.70	2.76	82,5 %
Can change the format of files	5.45	2.81	66,4 %
Can solve problems arising when using a computer or the Internet	5.17	2.74	88,1%
Can explain the advantages and limitations of computers in storing, organizing, retrieving and selecting information.	5.06	2.42	62,3 %
Is familiar with hardware/software compatibilities	3.58	2.78	37,2 %
Has knowledge of automation processes	2.63	2.53	25 %

Table 1. Mean, typical deviation and percentages of responses obtained in items relating to the use of computers, installation and configuration of programs and peripherals.

is a certain level of student homogeneity in these competences.

It is clear that most interesting data, especially because they are different, are those that relate to knowledge of automation processes and of hardware/software incompatibilities, where not only the mean score that subjects award themselves is very low (3.58 and 2.53 respectively), but also the vast majority consider that they are not in possession of these competences (scoring themselves below 5). What is more, in both these cases the most frequent score that students awarded themselves was zero. One further observation remains, that referring to the item «Solving problems that arise with computers or with the Internet». Here, the mean score for all the students is relatively low (5.17), although the great majority considered that they did not possess this skill.

3.2. Internet: information search, communication and collaboration tools

As table 2 shows, of the 22 items included in the questionnaire that relate to these skills there are only four in which the students do not, on average, consider themselves capable of performing – coordinating a group activity on the Internet; knowledge of how to send files from one computer to another via FTP; knowledge of how to use computer supported cooperative work; and how to sign up to RSS feeds from different readers. In general, we can say that the competences which students obtained highest average scores were those relating to downloading programs, use of search engines and browsers and the various online communication tools. And it is in these same competences where students present the most similar behaviour.

In contrast, the most heterogeneous behaviour is shown in the use of advanced search options, videoconferencing and sending files by FTP.

The only skill related to managing and searching for information in which the majority of the students

Competences	Mean	Typical deviation	Have this competence
Can create a free email account	8.99	1.691	97%
Can use usual Internet communication tools	8.96	1.591	98%
Can use different Internet browsers	8.65	1.646	96,5%
Can surf the Internet following the links and hyperlinks provided by the websites	8.03	1.997	94%
Can download programs, images and audio files.	7.88	2.062	93%
Can use different Internet search engines	7.76	2.115	94%
Can organize information collected from the Internet	6.81	2.811	83%
Can recognize most <i>spam</i>	6.53	2.590	83%
Can use ICT for research	6.42	2.272	83%
Is aware of the essential differences between free or open code software and proprietary software	6.29	2.741	80%
Can use the Internet to carry out videoconferences via IP (Netmeeting, Messenger, Skype...)	5.99	3.615	71%
Is familiar with the advanced search options of various browsers	5.89	3.091	71%
Can assess effectiveness of the uses made of information sources and ICT to improve classroom work	5.74	2.267	78%
Can use technological tools and resources to manage and communicate personal and professional information	5.60	2.396	72%
Can use computer programs to share information over the Internet	5.54	2.794	51%
Can assess authorship and reliability of information found on the Internet	5.40	2.428	68%
Can use the tools provided by operative systems to share resources using the classroom network	5.16	2.491	67%
Can use online help manuals	5.03	2.741	66%
Can coordinate an online group activity	4.83	2.849	62%
Can use FTP to send files from one computer to another	3.65	3.366	42%
Can use software for computer supported collaborative work	3.42	2.750	41%
Can sign up to RSS feeds through various readers	1.92	2.203	17%

Table 2. Mean scores, typical deviation and percentages of responses above the midpoint obtained for items related to the Internet.

(83%) score below the midpoint is in the use of RSS syndicators, where the most frequent rating is 0. It is especially noteworthy that while downloading information is one of the students' strong points, sending FTP documents over the Internet scores very low, with 58% below 5 and the most frequent rating 0 (which normally implies ignorance of the subject).

3.3. Creating and editing documents

A wide variety of skills are covered in this group. As the analysis will reveal, students have a considerably higher level in some than in others, in which they even score below the midpoint. The table below shows the mean scores, typical deviations and percentages of responses of 5 or above for each item.

What stands out here is that the mean score for most of these competences is below 5. Indeed, only 5 items (30% of the skills covered by this section) score

above 5 – ability to use a word processor to create a document; ability to use word processor spellcheckers; ability to organize, analyse and synthesize information using tables, graphs and diagrams; ability to use a computer program to create a multimedia presentation; ability to identify aspects of style in a visual presentation performed by a third party.

Nevertheless, if we consider the percentage of students awarding themselves a score of 5 or more, we see that the percentages of skills acquired are inverted and, as table 3 shows, there are 10 in which the majority of students score themselves above 5, i.e. they consider they possess this skill.

This apparent «contradiction» between the two types of data is explained by the fact that while in those skills that lie at an intermediate point (can use a computer program to create images and graphs; can use a computer program to create or edit audio sequences; can use a computer program to design, create and modify spreadsheets; can judge and contribute to improving multimedia productions produced by colleagues; can consult databases compiled by third parties) the majority of students score themselves with 5 or more, they do so with low scores, while those who «fail themselves» do so with very low marks. In fact, 0 is the most frequent score among those who consider they do not possess the skill in question.

3.4. Tools available at the University of Murcia

Students obtained quite high scores in all the items in this group since, let us not forget, it deals with tools that in the main the students have been familiar with since they entered the University.

100% stated that they knew how to use the online classroom (SUMA), with 10 being the most frequent score awarded and with a mean of 9.04. We would highlight that the typical deviation here was 1.259, which shows that students scored themselves very similarly and with very positive results. As regards use as customers of the university webmail, 90% of those surveyed placed themselves above the midpoint and

Competencias	Media	Desviación típica	Tiene la competencia
Capacidad para crear un documento escrito con un procesador de textos	8,48	1,75	99%
Conocimiento para utilizar los correctores ortográficos de los procesadores de texto	8,10	2,00	99%
Capacidad de organizar, analizar y sintetizar la información mediante tablas, gráficos o esquemas	6,62	2,35	87%
Conocimiento para crear una presentación multimedia mediante algún programa	6,44	2,54	85%
Conocimiento para identificar aspectos del estilo de una presentación visual realizada por otra persona	6,35	2,26	85%
Conocimiento para crear imágenes y gráficos mediante algún programa informático	4,86	2,67	60%
Conocimiento para crear o editar fragmentos de audio con algún programa informático	4,88	2,90	54%
Conocimiento para diseñar, crear y modificar hojas de cálculo con algún programa informático	4,65	2,77	59%
Capacidad para juzgar y hacer aportaciones para mejorar las producciones multimedia, realizadas por mis compañeros	4,49	2,55	85%
Capacidad para realizar consultas en bases de datos elaboradas por otros	4,37	2,72	55%
Conocimiento para diseñar, crear y modificar hojas de cálculo con algún programa informático de forma avanzada	3,46	2,72	40%
Conocimiento para diseñar, crear y modificar bases de datos con algún programa informático	3,26	2,81	37%
Conocimiento para diseñar páginas web utilizando algún programa informático	3,18	3,01	39%
Conocimiento para diseñar páginas web utilizando algún programa informático de forma avanzada	2,84	2,85	33%
Conocimiento para diseñar, crear y modificar bases de datos con algún programa informático de forma avanzada	2,54	2,51	25%

Table 3. Mean scores, typical deviation and percentages of responses above the midpoint obtained for items relating to document creation and editing.

10 was the most frequent score awarded (35%).

In the case of information consultation through the web or the online campus, we found that again 100% of students stated that they knew how to access their academic records through the SUMA online secretary. This is the skill in which the students awarded themselves the highest mean score and in which the deviation was lowest. These data also reflect that consultation of academic records through the online campus was the skill that was scored highest by the students and in which there was most homogeneity.

Furthermore, 98% stated that they knew how to consult timetables, classrooms and examination dates through the directories available on the university web, with 93% declaring that they were able to find teachers' email addresses and telephone numbers using the web directory of a given Faculty. As for using the various electronic resources (catalogues, journals, databases) on the library web, 82% of students scored themselves higher than the midpoint.

When asked if they knew how to configure SUMA to receive their grades by text message, only 57% scored themselves above the midpoint, which is

in contrast to the previous high percentages of almost all the students. Moreover, the mean score obtained here is 4.86 and the typical deviation stands at 3.745, indicating a high level of heterogeneity for the competence.

Finally, 65% of students stated that they were familiar with their rights and obligations as users of the University of Murcia web, as opposed to 35% who scored themselves below the midpoint. In this case 5 was the most frequent score recorded.

The table below gives the means, typical deviations and responses above the midpoint of the students for this category of skills. In general terms, we can say that all the students scored well on average for the different tools available at the University of Murcia. The skills in which they scored lowest and in which they revealed the most heterogeneous behaviours were those relating to setting up SUMA for text message reception of grades, in which the mean score did not reach 5, and those related to knowledge of their rights and obligations as users of the University web, in which they barely passed.

Competences	Mean	Typical deviation	Have this competence
Can use SUMA	9.04	1.259	100%
Can use the customer webmail service of the University	7.85	2.458	90%
Can access one's own online academic record	9.45	0.997	100%
Can consult information on the University of Murcia web directory	8.89	1.445	98%
Can configure SUMA for text message reception of grades	4.86	3.745	57%
Can use the website directory to find Faculty teachers' email addresses and telephone numbers	7.87	2.211	93%
Is familiar with the various electronic resources available on the University Library web	6.29	2.619	82%
Is aware of his/her rights and obligations as a user of the University web	5.25	3.029	65%

Table 4. Mean, typical deviation and percentages of responses above the midpoint for items relating to the tools available at the University of Murcia.

3.5. Analysis according to specialities

To conclude we are going to make a brief analysis of the most outstanding competences according to specialities. As we said at the beginning, the sample comprises students from Primary Education (33.6%), Foreign Languages (25.9%), Special Education (23.9%) and Music (16.5%).

Of the total number of students with above the mean basic knowledge of computers and their peripherals, 32% were from Primary, 16,5% from Music, 25% from Foreign Languages and 22% from Special. As for installation of programs, Primary accounted for 25%,

Music 16%, Foreign Languages 23% and Special 19%.

When it came to using word processors to create written documents a third of those with above the mean scores came from Primary, 16% from Music, 26% from Foreign Languages and 22% from Special.

One of the competences in which students scored particularly low was in the compilation of databases. The breakdown of those scoring above the mean was: 11% Primary; 11% Foreign Languages; 9% Music and 8% Special.

4. Conclusions

In our opinion the data provided here supposes a series of consequences that if not exactly worrying are arresting. First, it is interesting to know that our future teachers do not exhibit major problems in using, configuring and installing programs and peripherals. However, the fact that the lowest scores occur in automation mechanisms means that while the person is using these technologies, s/he is not making the fullest use of them to optimize performance with ICT work and to reduce the printing load of associated tasks.

As for the use of search, communication and collaboration tools, it is clear, as the graph below summarizes, that future teachers master the majority of the web tools where these skills are required.

However, the main shortcomings appear in skills related to collaboration, leadership and managing information in groups. This could compromise to some extent the students' skills as leaders of working groups (centres, circles, departments, interdisciplinary working groups, etc.).

Sadly surprising are the results that are forthcoming from the questions on creating, editing and assessing of media. The scores recorded here border in general on the mediocre, when they are not downright bad, with more than half the skills being scored below 5 and with few students indeed who believe themselves to possess the competences described. All this is very important for a number of reasons. In personal terms, our students – the future teachers – can be said to be not very skilful in expressing themselves in the new relevant formats of today's world. They do not master either the formats themselves or how these are created. In general this is somewhat worrying, but much more so if we

consider that we are talking about future teachers, and that a large part of their work involves creating, editing and adapting media in today's schools where computer media are a key feature.

Nevertheless, on the up side, we do know that the university years of those surveyed have served to provide them with sufficient knowledge of institutional ICT tools.

5. Discussion and new searches

Some of the conclusions of this study (which is of limited form and scope) were viewed with suspicion by those of us who, directly or indirectly, are very involved in the teaching profession. However, we believe that these objective results serve, at least, to clarify issues when looking at specific aspects of teacher training students in depth. This is especially interesting if we take into account that beyond the specific skills of managing one tool or another, this questionnaire assesses the students' own perception of their technical qualities and it is clear that often they are dissatisfied. This is why we believe that besides reinforcing certain areas of technical mastery that will be worked with in the coming years, it is also important to reinforce students' own perception so that they believe themselves to be capable of doing these things, for we are in front of a large doorway to knowledge (especially in that referring to the creation and assessment of media) and we have the possibility of daring to take on the enormous number of tools for creation and publication that appear every day in the world of the ICT.

At the same time, we believe that it is vital to complement this partial view of teachers' ICT skills with other future views which will go deeply into the other four areas that make up ICT competence in other spheres. It continues to be a rich area in which to look and one that can show us spheres of action in which teaching can be improved. So, we will continue to search.

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